

Case 10061(2)

## Claims:

1. A method of reducing formation breakdown during the drilling of a wellbore which method comprises:
  - (a) circulating a drilling mud in the wellbore comprising (i) an aqueous or oil based fluid, (ii) at least one fluid loss additive at a concentration effective to achieve a high temperature high pressure (HTHP) fluid loss from the drilling mud of less than 2 ml/30 minutes wherein the HTHP fluid loss is determined using an HTHP test according to the specifications of the American Petroleum institute (API), as described in API Recommended Practice 13B-2 Third Edition, February 1998, Section 5.2.1 to 5.2.3 or Recommended Practice 13B-1 Second Edition, September 1997, Section 5.3.1 to 5.3.2, and (iii) a solid particulate bridging material having an average particle diameter of 25 to 2000 microns and a concentration of at least 0.5 pounds per barrel ( $1.43 \text{ kg/m}^3$ );
  - (b) increasing the pressure in the wellbore to above the initial fracture pressure of the formation such that fractures are induced in the formation and a substantially fluid impermeable bridge comprising the solid particulate bridging material and the fluid loss additive(s) is formed at or near the mouth of the fractures thereby strengthening the formation;
  - (c) thereafter continuing to drill the wellbore with the pressure in the wellbore maintained at above the initial fracture pressure of the formation and below the breakdown pressure of the strengthened formation.
2. A method as claimed in Claim 1 wherein the pressure in the wellbore in step (c) is maintained at least 300 psi (2.07 M Pa) above the initial fracture pressure of the formation and below the breakdown pressure of the strengthened formation.

3. A method as claimed in Claims 1 or 2 wherein the solid particulate bridging material is added to a circulating drilling mud having an HTHP fluid loss value of less than 2 ml/30 minutes prior to increasing the pressure in the wellbore to above the initial fracture pressure of the formation.
- 5 4. A method as claimed in any one of the preceding claims wherein the strengthened formation is a depleted formation.
5. A method as claimed in any one of Claims 1 to 3 wherein the strengthened formation is a weak formation in a previously drilled section of wellbore.
6. A method as claimed in any one of the preceding claims wherein the drilling  
10 mud has a HTHP fluid loss value of less than 1 ml/30 minutes, preferably less than 0.5 ml/30 minutes.
7. A method as claimed in any one of the preceding claims wherein the concentration of solid particulate bridging material in the circulating drilling mud is at least 10 lb per barrel (26.6 kg/m<sup>3</sup>), preferably at least 15 lb per barrel (42.9 kg/m<sup>3</sup>).
- 15 8. A method as claimed in any one of the preceding claims wherein the drilling mud is recycled to the wellbore after separating material having a size of greater than 500 microns therefrom using a 35 mesh screen (US sieve series).
9. A method as claimed in Claim 8 wherein fresh solid particulate bridging material is added to the drilling mud prior to recycling the drilling mud to the wellbore.
- 20 10. A method as claimed in any one of Claims 1 to 7 wherein the drilling mud is recycled to the wellbore after separating drill cuttings from the drilling mud using a centrifuge or hydrocyclone.
11. A method as claimed in Claims 5 or 6 wherein a pill of the drilling mud having a concentration of solid particulate bridging material of at least 50 lb per barrel (143  
25 kg/m<sup>3</sup>) is circulated to the weak formation and is squeezed into the weak formation with the pressure in the wellbore in the vicinity of the weak formation maintained at above the initial fracture pressure of the weak formation.
12. A drilling mud composition comprising (a) an aqueous or oil based fluid; (b) at least one fluid loss additive at a concentration effective to achieve a high temperature  
30 high pressure (HTHP) fluid loss from the drilling mud of less than 2 ml/30 minutes wherein the HTHP fluid loss is determined using an HTHP test according to the specifications of the American Petroleum institute (API), as described in API Recommended Practice 13B-2 Third Edition, February 1998, Section 5.2.1 to 5.2.3 or

Recommended Practice 13B-1 Second Edition, September 1997, Section 5.3.1 to 5.3.2; and (c) a solid particulate bridging material having an average particle diameter in the range 50 to 1500 microns and a concentration of at least 0.5 pounds per barrel (1.43 kg/m<sup>3</sup>).

5 13. A drilling mud composition as claimed in Claim 12 having a specific gravity in the range 0.9 to 2.5.

14. A drilling mud composition as claimed in Claims 12 or 13 wherein the solid particulate bridging material comprises at least one substantially crush resistant particulate solid selected from the group consisting of graphite, calcium carbonate  
10 (preferably marble), dolomite, celluloses, micas, sand and ceramic particles.

15. A drilling mud composition as claimed in any one of Claims 12 to 14 wherein the concentration of the solid particulate bridging material is at least 10 pounds per barrel (28.6 kg/m<sup>3</sup>), preferably at least 15 pounds per barrel (42.9 kg/m<sup>3</sup>).

16. A drilling mud composition as claimed in any one of claims 12 to 15 wherein  
15 the solid particulate bridging material has an average particle diameter in the range 250 to 1000 microns.

17. A drilling mud composition as claimed in any one of Claims 12 to 16 having an HTHP fluid loss value of less than 1 ml/30 minutes, preferably less than 0.5 ml/30 minutes.

20 18. A drilling mud composition as claimed in any one of Claims 12 to 17 wherein the fluid loss additive(s) is selected from organic polymers of natural or synthetic origin and finely dispersed clays.

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